atmosphere was equilibrated, and another round of measurements were made. The procedure was repeated until the samples were measured in all of the desired atmospheres at a particular temperature. At this point the temperature was changed and the process repeated. After all of the measurements had been made the furnace was cooled to room temperature and the samples removed.

For the sensor array chips, a measurement system similar to that described above can be used. The only difference is that the platinum wires, which are connected to the inconel wires in the furnace, must be connected to the electrode pads on the array chip using a conducting paste (Pelco product #16023). The number of connections from the sample to the switch depends on the number of sensors on the array.

Example 1

This example shows the change in the electrical properties of 20 metal oxide semiconducting materials in the presence of 4 combustion gas compositions at 450°C. The signals listed in Table 1 below are from the infrared thermographic technique described above. The signals represent differences in temperature (°C) of the materials when exposed to one of the 4 gas compositions shown relative to that in a comparison gas which is 2% O_2/ 98% N_2 and reflect the change in the electrical resistance of the semiconducting materials. All of the signals were generated with 10 V across the materials, unless otherwise specified. Blank spaces indicate that there was no detectable signal when that gas composition was contacted with that material. Unless otherwise specified, the gases were measured at 2000 ppm in N_2.

Table 1
Change in temperature in °C

	ZnO	SnO_2	$NiFe_2O_4$	WO_3	1% Nb:TiO_2	Pr_6O_{11}	$SrNb_2O_6$
NO_2 in N_2	-38.1	-35.4	-27.4	-16.4	-2.7	-5.6	-2.8
NO_2 in 2%	-35.2	-32.5	-13.7	-13.5	-2.7	-	-

O_2/ 98% N_2							
CO in N_2	27.2	8.2	14	13.7	-	-	8.3
N_2 ref.	16.9	9.6	11.2	5.6	12.4	-	-

	NiO	CuO	Cu_2O	$MnTiO_3$	$BaCuO_{2.5}$	$AlVO_4$	$CuMnFeO_4$
NO_2 in N_2	5.5	8.2	8.2	5.6	6.6	-	-
NO_2 in 2% O_2/ 98% N_2	5.5	5.6	5.5	-	2.6	-2.7	2.6
CO in N_2	-	-5.5	-13.8	-	-2.7	11.3	-
N_2 ref.	-2.8	-5.6	-2.8	-	-2.7	8.3	-

	$LaFeO_3$	$CuGaO_2$	$CuFe_2O_4$	Zn_4TiO_6	La_2CuO_4	$SrCu_2O_2$
NO_2 in N_2	-	-2.8	-5.5	-5.7	4.2	-
NO_2 in 2% O_2/ 98% N_2	-	-	-2.5	-	-	2.6
CO in N_2	-2.8	-	-	7.3	-	-
N_2 ref.	-	-	-	-	-	-

The following measurements were done with other than 10 V. Pr_6O_{11} was measured using 1 V; $BaCuO_{2.5}$, $CuMnFeO_4$, $CuGaO_2$ and $CuFe_2O4$ were measured using 16 V; Zn_4TiO_6 was measured using 20 V; $LaCuO_4$ and $SrCu_2O_2$ were measured using 12 V.

Example 2

This example shows the change in the electrical properties of 8 metal oxide semiconducting materials in the presence of 5 combustion gas compositions at 450°C. The signals listed in Table 2 below are from the infrared thermographic technique. The signals are differences in temperature (°C) of the semiconducting materials when exposed to the gas compositions shown relative to that in a comparison gas which is 2% O_2/ 98% N_2. All of the signals were generated with 10 V across the semiconducting materials, unless otherwise specified. Blank spaces indicate that there was no detectable signal when that gas composition was contacted with that material. Unless otherwise specified, the gases were measured at 2000 ppm in N_2.

Table 2

Change in temperature in °C

	ZnO	SnO_2	WO_3	$SrNb_2O_6$	NiO	CuO	Cu_2O	$AlVO_4$
NO_2 in N_2	-38.1	-35.4	-16.4	-2.8	5.5	8.2	8.2	-
NO_2 in 2% O_2/ 98% N_2	-35.2	-32.5	-13.5	-	5.5	5.6	5.5	-2.7
CO in N_2	27.2	8.2	13.7	8.3		-5.5	-13.8	11.3
N_2 ref.	16.9	9.6	5.6	-	-2.8	-5.6	-2.8	8.3
1% C_4H_{10}/ 99% N_2	38	28	22	-	-6	-7	-11	11

Example 3

This example shows the change in the electrical properties of 26 metal oxide semiconducting materials in the presence of 4 combustion gas compositions at 600°C. The signals listed in Table 3 immediately below were obtained using an infrared thermographic technique. The signals are measurements of the differences in temperature (°C) of the materials when exposed to the gas compositions shown relative to that in a comparison gas which is 2% O_2/ 98% N_2. All of the signals were generated with 10 V across the materials, unless otherwise specified. Blank spaces indicate that there was no detectable signal when that gas composition was contacted with that material. Unless otherwise specified, the gases were measured at 2000 ppm in N_2.

Table 3
Change in temperature in °C

	ZnO	SnO_2	$NiFe_2O_4$	1% $Nb:TiO_2$	WO_3	$FeTiO_3$	$SrTiO_3$	NiO
NO_2 in N_2	-54.4	-48.3	-36.3	-24.2	-18.1	-6.1	3	6
NO_2 in 2% O_2/ 98% N_2	-48.3	-48.3	-30.2	-12.1	-18.1	-6.1	6	6
CO in N_2	28.5	18.1	18.5	42.3	24.1	-	-	-6
N_2	30.2	24.1	15.1	24.1	6	3	-	-9.1

	$AlVO_4$	CuO	Cu_2O	$LaFeO_3$	$BaCuO_{2.5}$	Fe_2O_3	$SrNb_2O_6$	ZnO + 2.5% F2889